From the Record of
Developmental and Experimental
Ordnance . . . Volume 17

THE SUB-MACHINE GUN

R E S T R I C T E D

The Record of Developmental and Experimental Ordnance

VOLUME 17.

SMALL ARMS

Office of the Chief of Ordnance, Research and Development Service . . . Washington, D. C.

THE SUBMACHINE GUN

DEVELOPMENT

THE term "submachine gun" is used in the United States to designate those weapons known in Europe as "machine pistols"—which is, perhaps, more accurately descriptive nomenclature.

Guns of this type are used by all the warring nations and are considered essential equipment for such shock units as paratroopers and commando groups which engage at close range and under conditions where success may depend upon intensely concentrated firepower swiftly and accurately delivered.

Standard in the Army of the United States is the Submachine Gun, cal. .45, M3, illustrated in Fig. 1. No better exemplification could be found of the statement that the American soldier is the best equipped fighting man in the world.

The gun itself is remarkable but even more noteworthy is the circumstance that it was in production within less than one year from July 1942 when the Technical Division of the Ordnance Department authorized the development of a weapon of its particular type.

The Submachine Gun, M3, is a caliber .45 weapon weighing 8 pounds, 15 ounces, complete with magazine, oiler, and sling. Its overall length is 29.8 inches which is shortened to 22.8 inches when the extension stock—which may be used in emergency as a cleaning rod—is closed. The 230-grain ball of the cal. 45, M1, cartridge is projected through an 8-inch barrel rifled with four right-hand twist grooves. The pitch, or twist, is one turn in 16 inches. An alternative rifling

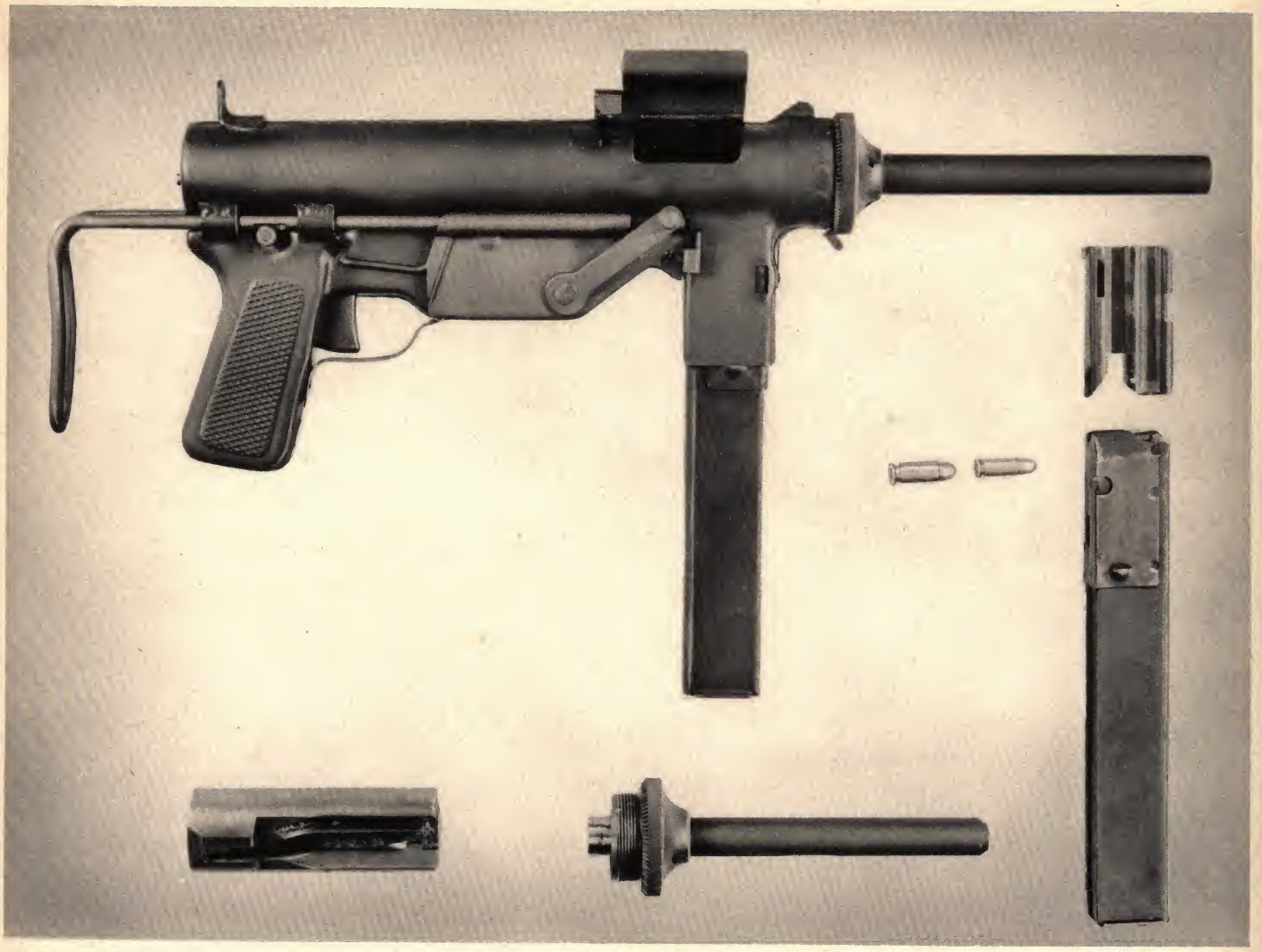

Fig. 1. Submachine Gun, Cal. .45, M3, showing cal. .45 and 9 mm cartridges and conversion parts.

of one turn in 15 inches is permitted the manufacturer.

The gun operates upon the straight blowback principle, the fixed firing pin in the heavy bolt firing the cartridge at the completion of the forward stroke. The major portion of the energy of the explosion is thus absorbed by the inertia of the bolt. When this is overcome, the remaining energy of the explosion is sufficient to drive the bolt to the rear against the compression of the operating springs. The fired case is ejected on the retracting stroke and the compressed dual springs furnish power to return the bolt to the firing position, picking up and chambering another round on its forward movement.

The use of a heavy bolt holds the cyclic rate of fire of the M3 to approximately 400 rounds per minute. This low rate of fire and the design which places the heel of the stock in almost a straight line with the axis of the bore combine to reduce recoil, virtually to eliminate muzzle-climb, and to produce unusual accuracy whether the weapon be used with stock extended or as a "two-hand" pistol.

Although made for U. S. service in caliber .45, the Submachine Gun, M3, may be converted to a 9 mm weapon by substituting a barrel of that caliber, a replacement bolt and a magazine adapter—an operation requiring but a few minutes and accomplished without tools. Thus converted it will handle not only the 9 mm British standard cartridge but will also function with captured German 9 mm Parabellum rounds. These conversion components are not standard and it should be emphasized that the M3 will not function with all 9 mm pistol cartridges. The Parabellum is

Fig. 2. Thompson Submachine Gun, M1928A1.

loaded for several German and Italian service weapons, but the 9 mm cartridge is as popular on the Continent as the caliber .38 in America and is loaded in many case sizes and bullet weights. Cartridges longer than the 1.16 inches of the Parabellum will not fit in the M3 magazine or chamber; satisfactory functioning of the shorter 9 mm cartridges is problematical, to say the least. A special 9 mm semi-armor-piercing cartridge is loaded for the German Schmeisser pistol. Use of those high-velocity loads would not be safe in an arm other than one designed for the increased pressures developed.

The program for the development of the submachine gun called for the manufacture of pilot models of two weapons, one of caliber .45, the other of 9 mm, but the simpler device of interchangeable barrels and other parts was recognized and suggested by the Ordnance Department.

Stampings are used wherever possible in the manufacture of the M3, only the barrel, bolt and a few additional components require machining operations, no critical metals are employed, and the gun may be turned out by production-line methods at a minimum cost for a weapon of this type. The barrel, for example, is produced by a simple, speedy, and inexpensive broaching operation.

The many achievements represented by the Submachine Gun, M3, can be better appreciated by a brief description of the Thompson Submachine Gun, M1928A1 (Fig. 2), which was Standard on 6 February 1941 when the original program for a more satisfactory weapon of this type—a program which led to the development of the M3—was undertaken.

In its existing form the Thompson represented twenty years' development since it was patented in 1920. It was an air-cooled weapon operated by delayed blowback and equipped with a walnut stock for firing from the shoulder. It was fitted with a compensator. Bolt, receiver, and barrel groups required precision machining to close tolerances and virtually all parts of the gun called for the employment of skilled operators and for the use of metals which even as early as 1940 were recognized as critical.

By any comparison with the M3 the Thompson, M1928A1, was an exceedingly complicated weapon. It was also expensive, the unit cost on 1 January 1941 being $420.00.*

The true value of the Submachine Gun, M3, cannot be appreciated unless those facts relative to the M1928A1 are made clear. To continue that compari-

*It should be remarked that a year later, 1 January 1942, production economies had reduced this figure to $200, still nearly six times the cost of the first production models of the M3 and approximately nine times the present unit cost of that weapon.

son the text of instructions for one operation—the removal of the barrel—of each gun is here repeated.

> *M1928A1:* Disassemble the gun, wedge a block of hard wood in the receiver to prevent springing of the side, clamp receiver in a vise with leather jaws, and unscrew barrel from the receiver, using a strap wrench.

Disassembly of the Thompson, M1928A1, is in itself a detailed operation. It will be noted, too, that a vise with protected jaws and a special type of wrench are required for the removal of the barrel.

> *M3:* Spring the ratchet assembly away from the barrel collar and unscrew the barrel.

No tools whatever are needed. The operation requires only a few seconds.

Figure 3 shows the Submachine Gun, M3, fully taken down for convenient stowing in a soldier's pack, for shipment, or for packing in standard containers to be dropped by parachute. The barrel and magazine are removed and the extension stock is folded. The gun occupies a space 12⅝ inches long, 7⅜ inches high, and 3⅛ inches deep—or 291 cubic inches.

The following significant reference to the M3 gun is quoted from the Second Summary Report of the Aberdeen Proving Ground on all submachine guns tested up to 10 April 1943. "Although it would be dangerous to state that further improvements and developments are unlikely, the ultimate has been reached in this type of weapon for the time being and production may begin without fear of immediate change."

That conclusion was reached at the end of the long series of tests which led to the adoption of the Submachine Gun, M3. Not until such an assertion could be made was production ordered.

Before proceeding to a report of the exhaustive tests conducted by the Ordnance Department before that ultimate was reached it would be well to sketch the general historical background of the submachine gun; a chapter in the larger history of the demand for firepower and still more firepower to be placed at the command of the fighting man.

Neither any one weapon nor the progressive developments of any one inventor may be designated as the

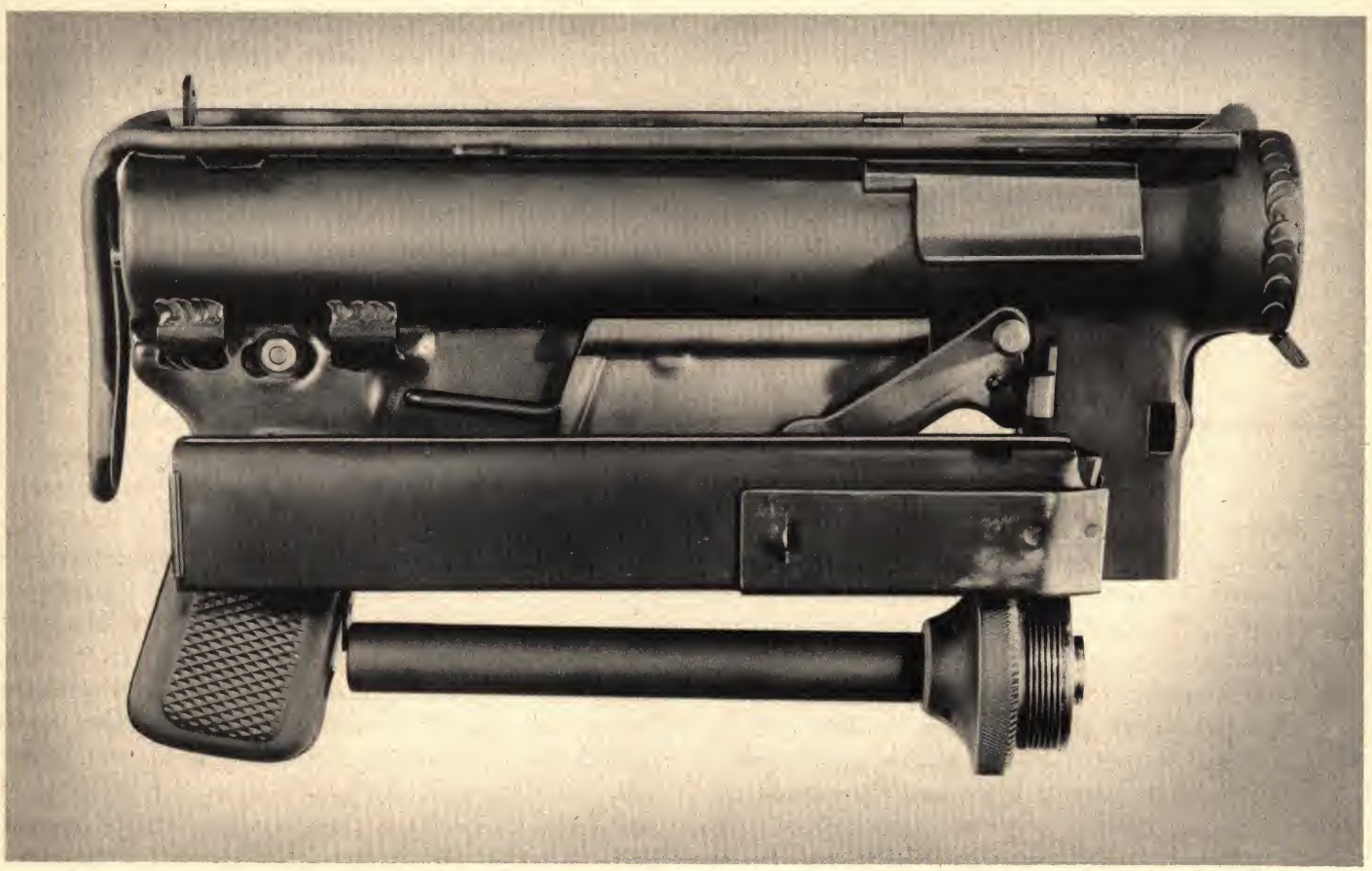

Fig. 3. Submachine Gun, M3, dismounted for packing.

prototype of the submachine gun. Its roots extend to the last decade of the 19th Century when the Borchardt pistol, the first self-operated handgun in history, was perfected by a Connecticut inventor, Borchardt, who had been associated in the manufacture of the famous Sharps rifles. The Borchardt pistol was manufactured commercially as early as 1893 by the Loewe Arms Company of Germany and eventually became the Luger, or Parabellum pistol, familiar as the standard sidearm of the German Army during World War I. The Luger still retains the toggle-breech mechanism and recoil operation which were features of the original Borchardt.

The next few years saw the development of the first Bergmann automatic pistol, the Steyr-Mannlicher, the Schwarzlose, and many others which never progressed beyond the experimental stage.

It was in 1896 that Paul Mauser began manufacture of the pistol which bears his name and which has undergone very few modifications since it was first placed on the market. Demand for increased firepower brought about minor changes in Mauser design in 1932. A detachable box magazine replaced the original clip-loaded cartridge-well and a selector was added to permit full-automatic as well as semi-automatic fire.

During World War I some units of the German army were equipped with the Bergmann "Muskete" —a recoil-operated carbine with provision for either full- or semi-automatic fire and which closely approached the submachine guns of today. The same conflict saw the development of two 9 mm Italian guns: the remarkably compact Villar-Perosa gun, adopted by the Italians as a weapon for mountain fighting and for bicycle troops in operations where light weight, portability, and firepower were factors; and the Beretta carbine, also a Villar-Perosa production.

The Villar-Perosa is actually a miniature of a standard machine gun. It is twin-mounted and feeds from box magazines set above the side-by-side actions. It was never equipped with shoulder-stocks nor adapted for use in pistol form. The Beretta—used with but slight changes in the Italian Army today—is a machine carbine which differed but little from many submachine guns which followed a decade later. It was blowback operated, fired a 9 mm bullet, and was equipped with a short bayonet, folding on some models. Although functioning well under normal use, and still considered the best of the Italian small arms, the faulty design of the original model is best shown by the fact that the coil-spring and bolt-rod were exposed for the major portion of their length. Dirt and foreign matter had easy access to the gun's action and malfunctions were frequent.

The Mauser is a 7.63 mm, short-recoil operated pistol with a capacity of ten cartridges loaded singly or by clip into a box magazine in front of the trigger-guard. It has been criticized because the tapered cylindrical grip and muzzle-heaviness of barrel and magazine contribute to poor balance, but it is considered by many to be the best and most reliable automatic pistol ever produced. Its 85-grain bullet is the lightest fired by any military pistol, yet its muzzle velocity of 1,300 feet per second is 60 percent greater than that of the U. S. pistol, cal. .45, M1911, and its 329 foot pounds muzzle energy is exceeded only by the 9 mm Steyr and Bayard cartridges of Austria and Denmark and by the Colt "Super .38 Automatic" cartridge, standard in several South American armies. At ranges of 100 yards or more the Mauser is far more accurate than the M1911 pistol or other contemporary weapons.

Although called a "military model" when first produced in 1896, the Mauser was never adopted as standard by the German or any other army, possibly because of its high cost. It has been widely used, however, and was a favorite sidearm of many German and Austrian officers during the years 1914–1918.

The demand for firepower and still more firepower to be placed at the command of infantry troops and of shock units greatly stimulated interest in the development of light automatic or semi-automatic weapons during the years which followed World War I. The famous "Tommygun" was patented in 1920 and was standardized in the United States Army as the Submachine Gun, Thompson, M1928. In its original form the Thompson was fed from drum magazines of 20- and 50-round capacity. A 20-round box magazine and a 100-round drum were also supplied.

German ordnance designers were active in the development of the machine pistol on the continent. The Bergmann "Muskete" which had been in limited service during World War I was subjected to various improvements and modifications which were to appear in the Schmeisser and the Steyr-Solothurn, Solothurn, and Neuhausen guns. Finnish designers produced the Suomi and the gifted Russian Degtyarov developed his own modification of the German Bergmann. Mention has been made of modifications of the Mauser pistol which placed that weapon definitely in the category of submachine guns although still a far more complicated weapon than was desirable.

In spite of the name "machine pistol," all the guns developed during that period were actually light, short-barreled automatic rifles. The Thompson, M1928, for example, weighed 15.70 pounds with a loaded 50-round magazine. The 10.80 pounds of the Thompson, M1928A1, was nearly 2 pounds more than the weight of the U. S., M1903, cal. .30 rifle. The pioneer models of the Schmeisser and other foreign weapons were equally heavy. All—like the Thompson—were designed as shoulder weapons and were equipped with fixed wooden stocks of conventional length and drop. They were virtually useless as cavalry weapons: the drum and side-feeding magazines created a shifting center of gravity and torsional stresses upon the firers' left arms; they were too long for convenient stowage as auxiliary arms in tanks or vehicles and, as was to be learned, entirely too bulky for use by parachute troops.

The Blitzkrieg of 1940 introduced a new weapon. German paratroopers and motorcycle units carried a new, short Schmeisser weighing 8.25 pounds and equipped with a skeleton stock which when folded reduced the overall length of the arm to 24.5 inches. It was fully automatic in action and fired a 9 mm cartridge from a 32-round magazine.

The high efficiency and serviceability of the Schmeisser as demonstrated under combat conditions greatly stimulated interest in weapons of that type. Tests conducted by the Ordnance Department of the M1928A1 Thompson gun proved that such expensive devices as muzzle-brakes and compensators (used to prevent or reduce any tendency of the weapon to climb under full-automatic fire) were unnecessary so long as the recoil could be kept closely parallel to the centerline of the stock.

The using arms, Infantry and Cavalry, were then called upon for an expression of the characteristics desired in a submachine gun and expressed their respective requirements as follows:

	Infantry Requirements	Cavalry Requirements
Caliber	.30 or .45	.30 or .45
Cooling	Air	Air
Weight	7 to 10 lb.	Not more than 11 lb.
Length	36″	34″
Length without stock or with stock folded	23″	Removable or folding stock not essential
Sights	Open	Open, adjustable
Magazine capacity	50 rds.	20 and 50 rds.
Rate of fire	500 rds./min.	600 rds./min.
Type of fire	Auto. & semi-auto.	Auto. & semi-auto.
Grip	Pistol	Pistol
Sling	Yes	Yes
Maximum effective range	300 yds.	300 yds.

Those suggestions were recorded in O.C.M. 16455, 6 February, 1941, and guided the Small Arms Development Branch in preparing design specifications for a submachine gun. The specifications called for a blow-back operated weapon using the U. S. cal. .45, M1911, cartridge, Standard for submachine guns. While lugs, interrupted threads, or other locking devices were not declared essential, the action should be so designed that the breech remained closed until pressures fell below a point that might endanger or inconvenience the operator.

The weight, less magazine, was not to exceed eight pounds; the maximum length permissible was 35 inches. The weapon should be equipped with a safety device, have a cyclic rate of 600 ± 50 rounds per minute, and be capable of either full-automatic or semi-automatic fire. The last provision was later amended, semi-automatic fire control being found unnecessary. Further specifications directed that it should be possible to change magazines with the bolt in either the open or closed position.

Weapons submitted should be equipped with a rifle type of stock, a pistol grip, and a forearm for the operator's left hand. In full-automatic fire at 50 yards from a machine rest, the average of the extreme spread of five 20-round groups should not exceed eight inches. When fired from the shoulder, standing, at least half of the shots should group on a target six feet square.

At the recommendation of the Aberdeen Proving Ground several amendments were made in those specifications. The new requirements were that the bolt or breechblock should be as heavy as possible, the cyclic rate should not exceed 500 rounds per minute, and not less than 90% of the shots fired full-automatic from a standing position should strike a 6′ x 6′ target at 50 yards.

Manufacturing and production details were also studied. The United States was still a nonbelligerent during the eighteen months which followed the invasion of the Low Countries and the fall of France, but it was realized that American industry might be called upon at any time to supply equipment and replacements for huge armies. In those circumstances, all items including submachine guns would have to be reduced to a production-line basis and no consideration could be given to weapons which required elaborate and expensive machining operations. The bolt of the Thompson, M1928A1, for example, was locked by means of a sliding wedge which required precise machining of both wedge and receiver. This represents

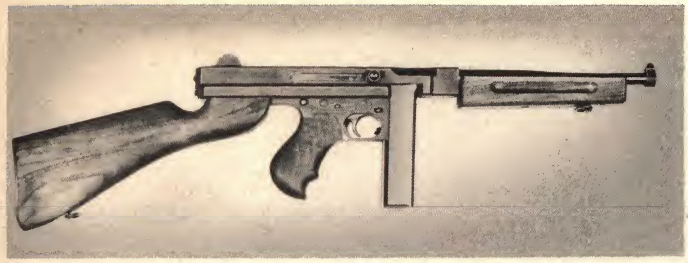

Fig. 4. Thompson Submachine Gun, M1.

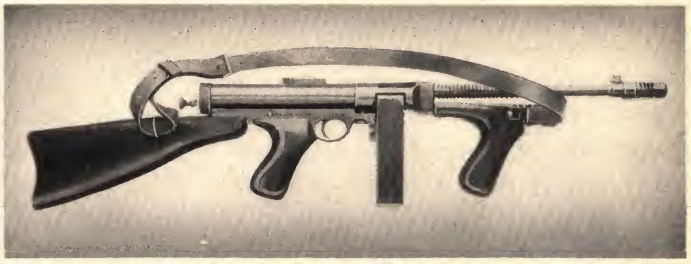

Fig. 5. Hyde 109. Note foregrip and exposed cocking-piece.

one form of the Blish mechanism which also includes the rotary bolt with chamfered locking lugs.

The requirements issued called for an all-metal gun, fabricated so far as possible from stamped parts to permit speed and economy of production and to require a minimum of machine operations and use little or no critical metal. Design was further simplified by eliminating any requirements for a sling or sling swivels as well as any selector device permitting full-automatic or semi-automatic fire. A single-speed, full-automatic weapon with a low cyclic rate would be acceptable.

As a first step toward the desired end, the guns of the Thompson series were studied with a view to their simplification. A minor change worthy of note was that breakage and splitting of stocks were overcome by incorporating a "through-bolt" in the design of guns of this series. The through-bolt extended the full length of the stock from the buttplate to the rear of the gun's frame which is seated in a well in the wooden stock.

Further development produced the Submachine Gun, Thompson, M1, (Fig. 4) which was far simpler than its immediate predecessors. The compensator was eliminated, the cooling fins disappeared from the barrel; and the elaborate, complicated, and expensive Blish locking mechanism was replaced by the simpler action of a heavy bolt. Production of the new gun required fewer operations at a saving of more than $25 per unit. The weight remained unchanged, however, and the stock was still of the conventional rigid design. The weapon was still far short of the goal desired for mass production.

A modification of the M1—M1A1—offered further simplification. In this gun the firing pin was machined integrally with the bolt, a step which eliminated the firing pin, firing pin spring, hammer, and hammer spring. Tests conducted at Springfield Arsenal and Aberdeen Proving Ground indicated that the functioning of the modified weapon was superior to that of the M1. Manufacture was simplified by the elimination of the deep drilling operations necessary to accommodate those moving parts within the bolt and cost of production was still further reduced.

The sequence of models can be best presented by considering the Hyde and Hyde-Inland weapons. The gun here identified as Hyde 109 (Fig. 5) was the first submachine gun designed by George J. Hyde and was subjected to exhaustive tests at Aberdeen Proving Ground between 5–27 October and on 21 November 1939. A total of 1,534 rounds was fired.

The gun was a straight blowback weapon firing the U. S. cal. .45, M1911, cartridge through an 11.25-inch barrel finned for cooling and fitted with a compensator. The 20- or 40-round magazines were inserted from below. There was no forestock but a pistol foregrip was mounted below the barrel. The cocking-piece was exposed, and its movement with each shot was approximately .5 inch toward the gunner's eye. While there was little danger of actual injury, the feature presented a mental hazard and was objectionable. Muzzle flash, bright yellow in color, was pronounced.

Accuracy—The following results were obtained at 1,000 inches, machine rest, 10 rounds on each of three targets, semi-automatic fire; 20 rounds on each of five targets, full-automatic:

Average Semi-auto.	Extreme Horizontal Dispersion	Extreme Vertical Dispersion	Extreme Spread
Hyde	2.05″	3.88″	4.10″
Thompson	2.73″	1.55″	3.04″
Full-auto.			
Hyde	1.91″	4.55″	4.67″
Thompson	2.87″	5.17″	5.47″

After each of the four dust and mud tests to which it was subjected the Hyde 109 functioned normally except for failure to feed caused by dirt blocking a weak magazine spring. It was necessary to clean the Thompson, M1928, after each test to restore normal functioning.

The Hyde 109 was judged far superior to the Thompson under adverse conditions of mud and dust; its functioning components were less complicated, it cooled more rapidly after full-automatic fire, handled more easily, and it had a lighter recoil.

The design of the trigger group was not satisfactory, the visible rearward motion of the exposed cocking-piece was objectionable, the magazine springs were weak, the flanges on the bolt face could be cracked or broken by falling on an empty chamber, and the forward grip was inadequately supported.

Service test of the gun in its existing form was not warranted. It was redesigned and a new gun, identified here as the Hyde-Inland I, was submitted to Aberdeen and tested on 2, 9, 10, 15 April 1942. All of the objectionable characteristics of the pilot model of the series Hyde 109, had been eliminated. The action had been completely enclosed and there were no external moving parts to disturb the operator or to catch in his clothing. Barrel-fins had been removed and the stock extended to enclose the barrel and protect the operator's hand. The straight blowback action was the same and the weapon was capable of either semi- or full-automatic fire, controlled by a selector. Bolt and firing pin were a unit. The gun was lighter than both the Hyde 109 and Thompson, M1928A1.

Accuracy—The gun was tested in competition with the Thompsons, M1928A1 and M1. Ten shots were fired from a machine rest, full-automatic fire, on each of three targets at a range of 100 yards. The composite figures for the 30 rounds were:

	E.H.D.	E.V.D.	E.S.
Hyde-Inland I	8.68″	9.53″	11.06″
Thompson, M1928A1	9.68″	10.24″	10.94″
Thompson, M1	6.38″	11.57″	9.20″

The test was repeated with the selectors set for semi-automatic fire. The three guns performed as follows:

	E.H.D.	E.V.D.	E.S.
Hyde-Inland I	6.90″	8.20″	9.20″
Thompson, M1928A1	6.28″	9.71″	10.57″
Thompson, M1	6.63″	8.20″	9.40″

At a range of 50 yards in full-automatic fire from the offhand position, the Hyde-Inland I placed 99 of 100 shots upon the 6′ x 6′ target. This compared with 50 hits for the M1 and 49 for the M1928A1. Those who fired the subject gun stated that it handled very well, that the recoil was soft, and that there was no appreciable tendency to climb under full-automatic fire.

One hundred rounds (ten targets) were fired offhand, semi-automatic, at a range of 50 yards. The following averages were recorded:

	E.H.D.	E.V.D.	E.S.
Hyde-Inland I	19.07″	28.87″	31.76″
Thompson, M1928A1 (average of 5 targets)	9.82″	10.24″	12.36″
Thompson, M1	13.72″	18.77″	21.01″

The subject gun was fired 6,080 rounds in the endurance tests. There were 20 malfunctions, 15 being failures of the bolt to remain open after the last round was fired. On three occasions the bolt remained open but closed when the magazine was withdrawn. The other malfunctions were one light firing-pin blow and one failure to feed.

The average cyclic rate was 527 rounds per minute. That of the Thompson, M1928A1, was 610; that of the M1 was 775.

Dust Test—Thirty rounds fired without malfunctions after the gun was subjected to the standard dust test. Only a negligible amount of dust was found to have penetrated the mechanism.

Mud Test—The gun failed to function after immersion in thin mud. The mechanism was well filled with mud and the operating handle spring lock broke when an attempt was made to manipulate it. The broken piece jammed the bolt in the retracted position.

It may be mentioned that the Hyde Inland I functioned very well in firing the cal. .45 tracer ammunition from the 30-round magazine supplied by the manufacturer. A total of 520 rounds was fired with only four failures to feed due to a faulty magazine. The cyclic rate with the lighter ammunition was 440 rounds per minute.

The conclusions reached were that the Hyde-Inland I was superior in accuracy to the M1 and M1928A1 in full-automatic fire from a machine rest but that it was poor in comparison with the control weapons in offhand semi-automatic fire. In full-automatic fire, offhand, it was superior to the control weapons or to any submachine gun submitted.

Service tests appeared warranted but the designer wished to make certain minor modifications and then resubmit the arm.

Hyde-Inland—Five guns—here identified under the heading Hyde-Inland 2—were submitted by the maker and tested 19, 21, 22 June 1942. They embodied minor modifications of the Hyde-Inland I and were fired only for functioning. A total of 2,640 rounds was fired and only two serious malfunctions recorded.

Recommendation was made that the magazine well be deepened so as to accommodate satisfactorily the optional 30-round magazine and that a heavier operating spring be used.

In full-automatic fire the gun jarred noticeably, indicating that the bolt was striking the buffer and lacked energy in the closing stroke.

Subject to those improvements being made the Hyde-Inland gun was recommended for standardization as the Submachine Gun, M2, but Ordnance Committee action classified the arm as Substitute Standard (30 April 1942). In view of the tremendous requirements for submachine guns at that time it was not considered advisable to convert existing facilities to the manufacture of the new weapon and an attempt was made to produce the M2 by awarding contracts to firms not then engaged in war work. Many difficulties were encountered, as was anticipated, and actual production models of the M2 did not reach Aberdeen until May, 1943, five months after the M3 had been standardized. Production of the M2 was discontinued.

During the period which covered the modification of the Thompson guns and the adoption of the M2 as a Substitute Standard item, more than twenty submachine guns of American and foreign manufacture were tested at Aberdeen Proving Ground. Those weapons and their performances under test are reported in the second section of this article.

All but a few were given the complete service test and the majority proved quite unfit for military use. With the exception of the Atmed, none would function satisfactorily under adverse mud conditions—a fault shared by the models then classified as U. S. Army Standard—and virtually all presented intricacies of design which forbade manufacture by production-line methods. The most general fault observed was an excessive cyclic rate which resulted in a marked tendency to climb under full-automatic fire. In the hands of inexperienced operators some guns were firing almost vertically by the time the last round in the magazine had been reached.

Still further simplification was essential. The records of the tests and the weapons themselves were carefully studied by officers of the Ordnance Department. Reports of the use of submachine guns in combat and in commando operations crystallized further the concept of the basic requirements for such a weapon —reliability, simplicity, compactness to permit packaging in small containers, and a low cyclic rate. The magazine should have a capacity of at least 25

Fig. 6. Submachine Gun, M2.

rounds and should be inserted from below. The only advantage of the side-feeding magazines, such as used in the British Sten, was in firing from the prone position; the disadvantages of such a feed were many.

Guns of the Sten series had been tested at Aberdeen and had been criticized because of their highly unorthodox appearance. The Sten demonstrated, however, that an efficient submachine gun could be made at small unit cost and by production-line methods, and officers of the Small Arms Development Branch realized that in modern warfare there are other criteria than mere appearance. They knew that huge numbers of weapons of this type would be required and directed all efforts toward the production of a gun which could be manufactured as easily, as swiftly, and as economically as the Sten.

Designs were prepared and specifications submitted to a firm of long experience in the production of stamped parts. That contractor agreed to make a production study of the Sten gun with a view to making a comparable weapon.

The gun was originally designated T15. The specifications were amended to provide for a cal. .45 weapon which would fire 9 mm ammunition by substitution of a lighter bolt, a magazine adapter, and a 9 mm barrel. The Sten magazine would be used with the modified weapon. Further simplification eliminated the requirement for a selector providing for semi-automatic as well as full-automatic fire. The modified weapon was designated T20.

Five pilot models of the T20 were tested at Aberdeen Proving Ground on 18, 19, and 24 November 1942. These were straight blowback weapons weighing 7.66 pounds in cal. .45 without magazine and 7.74 pounds when converted to 9 mm caliber. The cyclic rate of fire was approximately 400 rounds per minute and there was little or no tendency of the muzzle to climb. The guns were not equipped with selectors and

semi-automatic fire could be approximated only by a quick release of the trigger after each shot.

ACCURACY—Ten shots were fired, full-automatic, on each of two targets at 100 yards from a machine rest with both the cal. .45 and the 9 mm weapons. The test was then repeated with semi-automatic fire. Averages of the 20 shots at each type of fire and for the two calibers were as follows:

	E.H.D.	E.V.D.	E.S.
Full-automatic			
cal. .45	7.55″	5.65″	8.45″
cal. 9 mm	7.63″	5.65″	8.44″
Semi-automatic			
cal. .45	7.19″	7.61″	9.36″
cal. 9 mm	7.04″	6.04″	7.06″

Fired from the offhand position, full-automatic, at 50 yards, the T20 cal. .45 placed 97 of 100 shots upon the 6′ x 6′ target. At 100 yards, firing in short bursts, 67 hits were registered. The 9 mm weapon recorded 92 and 50 hits under the same conditions.

The above figures may be compared with the performance of five other submachine guns at the 50-yard range, full-automatic:

Thompson, M1, Cal. .45	89
Thompson, M1928A1, Cal. .45	93
M2, Cal. .45	84
Schmeisser, 9 mm	81
Sten, Mk. II, 9 mm	94

A total of 5,000 rounds was fired from the cal. .45 in an endurance test. Brass cases were used. There were two failures to feed, both caused by the follower sticking in the magazine well. There were three failures to eject and one failure to feed in the firing of 500 rounds of steel-cased ammunition.

Twenty-three failures to eject occurred during the firing of 5,000 rounds of 9 mm ammunition. The ejection port was too small. When the port was enlarged, 1,250 rounds were fired with no ejection failures.

DUST TEST—After the cal. .45 gun was subjected to the standard test of being exposed for 2½ minutes to agitated dry cement the first two rounds failed to feed. It was found that dust had jammed the magazine follower. A clean 30-round magazine fired normally.

The 9 mm gun failed to fire due to a small quantity of dust within the receiver. When this was wiped out the gun fired without malfunction.

MUD TEST—The guns were submerged and moved about in a mixture of road dust and water. With a muddy magazine the bolt of the cal. .45 gun twice failed to close. There was one failure to feed in 30 rounds fired from a clean magazine. The bolt of the 9 mm piece would close but failed to fire the round. Cleaning of the chamber and insertion of a clean magazine made no difference.

The final conclusion was that "this is the best weapon of this class to be submitted to the Proving Ground and it is easily equal to or better than the Sten or M2."

Those conclusions were confirmed by further tests conducted independently by the Airborne Command (Fort Bragg, N. C.), the Amphibious Warfare Board (Fort Carrabelle, Fla.), the Infantry Board (Fort Benning, Ga.), and the Armored Force Board (Fort Knox, Ky.). Those using arms were unanimous in their approval of the weapon and in their requests that it be standardized and placed in production immediately.

The Airborne Command reported the gun suitable for use by parachute troops. Twelve packaged T20s would fit into the standard A5 aerial delivery container for dropping by parachute. The only malfunctions during the firing of 385 rounds were caused by faulty design of the magazine.

The report of the Amphibious Warfare Board was in general agreement with that of Aberdeen Proving Ground. The gun was tested under simulated landing conditions. After being fired from a landing boat at targets on shore, it was dropped into the surf, picked up, and fired again. Functioning was satisfactory throughout the tests. Malfunctions in the firing of 265 rounds were caused by the jamming of the magazine follower.

The Infantry Board also suggested changes in the magazine. A total of 3,014 rounds was fired in the course of seven tests. The report of the Armored Force agreed with that of other using arms. The gun was found to be a better auxiliary arm for tank troops than any other standard submachine gun. A total of 3,558 rounds was fired at Fort Knox.

On 24 December 1942 the Ordnance Committee recommended the gun for standardization as the M3 (O.C.M. 19401). It is now in the hands of American fighting men in every quarter of the globe. The Ordnance Department took the best that American ingenuity and resourcefulness could offer; neither sentiment nor military conservatism were permitted to influence decisions; the goal was "the ultimate in a weapon of this type," and the M3 is the achievement of that objective.

SUBMACHINE GUNS TESTED

The scope of the research and experimentation conducted by the Ordnance Department is revealed by the long list of foreign and domestic submachine guns tested in the course of the project. The principal characteristics of those weapons appear in tabular form herewith and will be followed by a description of each gun and the results of its test.

Gun	Caliber	Weight Lb.	Length Ins.	Magazine Capacity	Action	Cyclic Rate
Atlantic	.38 ACP	8.78	35.25	30	Del. b.b.	508
Atmed	.45	9.48	33.6	25	b.b.	524
Austen	9 mm	8.54	33.5	30	b.b.	575
Bergmann	9 mm	9	33.5	32	b.b.	—
Hi-Standard	.45	8.75	33.1	20	b.b.	880
Hyde 109	.45	9.5	35	20–40	b.b.	762
Hyde-Inland (M2)	.45	9.08	33.9	20–50	b.b.	527
Olsen	.45	9.22	33.5	20	b.b.	1,111
Owen	9 mm	10.04	32	33	b.b.	812
Reising-1	.45	7.07	35	18	Del. b.b.	450
Reising-2	.45	7.37	35.75	20	b.b.	750
Schmeisser*	9 mm	8.25	35	32	b.b.	—
Smith & Wesson	9 mm	8.2	33.8	20	b.b.	Semi-auto. only
Star	9 mm	8.2	35.4	10–30	Del. b.b.	700 300 (two speeds)
Sten, Mk. III	9 mm	7.19	—	30	b.b.	537
Suomi	9 mm	10.5	33.8	20–25	b.b.	833
Thompson, M1928A1	.45	10.8	31.8	20–50	Del. b.b.	750
Thompson, M1	.45	9.5	33.69	20–30	b.b.	775
Thompson, T2	.45	8.6	—	20	b.b.	600
Turner (gas)	.45	5.32	—	20	Gas	1,483
United Defense†	9 mm/.45	7.96	32	25	b.b.	1,150
Woodhull	.45	8.12	33.5	10	b.b.	760

*The Schmeisser gun, a German weapon, was tested for purposes of study and not in competition with standard or subject arms.
†The United Defense was convertible, 9 mm to cal. .45, by substitution of barrel. Barrel not in use served as an extension stock.

The tests were conducted in accordance with directives issued by the Office of the Chief of Ordnance, amended and extended from time to time as the important characteristics of the submachine gun became more clearly formulated. In the reports of the earlier tests the actual results should be considered as well as the conclusions reached.

Each gun was subjected to a detailed examination, then fired for accuracy from a machine rest and from the offhand position. Where a selector was present, the tests included both full-automatic and semi-automatic firings. The guns were fired to determine general functioning and then tested for functioning under adverse conditions of dust and mud. The dust and mud tests were later standardized.

Tests indicated that the use of 9 mm (British) ammunition favored the gun, a more satisfactory performance being obtained with the lighter cartridge.

All of the weapons tested developed minor difficulties. An effort was made to evaluate only the fundamental characteristics, as follows:

(a) On reliability, the principal consideration was given to functioning under adverse conditions of dust and mud. All the guns performed fairly satisfactorily under normal conditions, but wide divergences appeared in the course of the dust and mud tests.

(b) Greater weight was given to accuracy under full-automatic fire. Accuracy when fired from the shoulder was considered more important than the weapon's performance in a machine rest.

The various submachine guns submitted are here reported in the order in which they were received and tested.

SMITH AND WESSON—A submachine gun firing the 9 mm Luger cartridge was manufactured by Messrs. Smith and Wesson who requested that it be given a

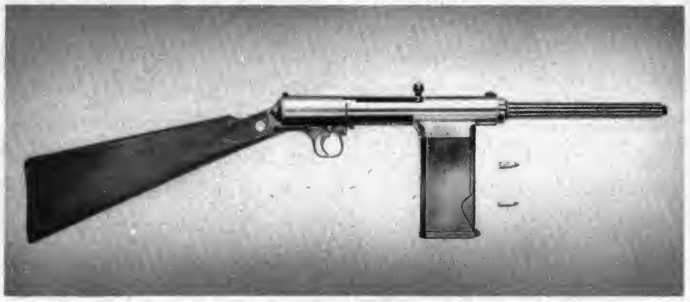

Fig. 7. Smith & Wesson, 9 mm.

Fig. 8. Reising—Collapsible stock model.

test sufficient to determine practicability of design and to reveal weaknesses which might be overcome in the projected manufacture of a similar gun in cal. .45. A pilot model (Fig. 7) was inspected and fired at Aberdeen Proving Ground, 28 November 1939. The weapon submitted was of the straight blowback type in which a 20-round magazine was inserted from below. No compensator or muzzle brake was used since there was no provision for full-automatic fire.

One hundred twenty rounds were fired for general functioning and 40 additional rounds were fired after the gun had been subjected to an informal dust test by being covered with dirt obtained at the firing point. After that dirt test it was difficult to pull the trigger on three rounds.

The inspection indicated that further tests would be justified if the weapon were modified to handle cal. .45 ammunition and to permit full-automatic fire. Certain mechanical changes were also suggested, one being to reduce the force with which the firing pin strikes the primer.

Should such changes be made, further tests were recommended. The makers did not submit a gun so modified.

REISING—The guns of the Reising series were designed by Eugene G. Reising and manufactured by the Harrington & Richardson Arms Co. The model first submitted for Ordnance tests was designated a "light rifle." It was a cal. .45 weapon weighing only 7.07 pounds with an empty 18-round magazine in place and had no provision for full-automatic fire. It was tested in competition with the Thompson, M1928, at Aberdeen Proving Ground on 8, 19, 20 August 1940.

The Reising had certain advantages over the Thompson, M1928, notably those of simplicity and ease of handling, but its disadvantages were such that it was not considered suitable for a military arm in its existing form. It should be noted that this model was changed to handle cal. .30 ammunition and submitted as a carbine. Modified so as to provide for full-automatic fire, it was submitted and tested as a cal. .45 submachine gun.

The first Reising submachine gun (Fig. 8) was tested 14, 15 July 1941. It was a delayed blowback weapon with a manually operated fire-control slide which could be placed in three positions for "safety," full-automatic, and semi-automatic fire. As submitted it was equipped with a combined flash-arrestor and muzzle brake which did not prove satisfactory.

Thirty-six malfunctions occurred during the firing of 1,020 rounds in the endurance test. Fifteen of those were caused by failure to feed, 20 by failure of the bolt to close tightly, and one by failure to eject the fired case.

ACCURACY—The Aberdeen report upon the first Reising includes the following figures as an average of ten shots on each of three targets, semi-automatic fire.

	E.H.D.	E.V.D.	E.S.
Prone, 1,000″ (80′, 4″)	3.75″	5.125″	5.25″
Standing, 1,000″	3.00″	5.125″	6.125″
Prone, 100 yards	9.00″	14.00″	15.50″

Full-automatic fire was tested in short bursts at a 25 yard range from the offhand position. Only one gunner, a recognized expert, was able to place all 20 shots on the 6′ x 6′ target. The extreme horizontal dispersion on this target was 4′, the extreme vertical 5′. The number of hits scored on the targets by other gunners ranged from 13 to 17 of the 20 fired.

The recoil was light but the gun had a decided tendency to climb even when short bursts were fired and was frequently off the target after only four rounds. Considerable force was necessary to hold down the muzzle in full-automatic fire.

SAND TEST—The gun was heavily oiled and sand and dust were thrown at it. Wiped and fired, it failed to function after three rounds. Complete disassembly and cleaning in solvent was necessary before more than three rounds could be fired.

MUD TEST—The gun was immersed in thin mud and fired after superficial wiping. Even with a clean magazine inserted it would fire only one shot. Disassembly and cleaning was necessary as after the sand test.

DUST TEST—After being showered with dust upon all its exposed surfaces the gun refused to fire more than one round even though inspection showed very little dust in the mechanism. The bolt, action slide, and magazine are exposed and it is almost impossible to prevent foreign matter from entering. The large trigger-hole in the stock also affords access to dust and other matter. The presence of a very small amount of dust or sand completely halts the functioning of the gun.

The weapon was returned to the makers for correction of the defects noted. It was resubmitted and tested on 8, 10, 12, 17 November 1941. There appeared to be no essential differences between the second model and that previously tested except that the new gun appeared to be more carefully made.

The new Reising was tested in competition with the Thompson, M1928A1, according to the following schedule.

ACCURACY—Ten shots were fired, full-automatic, machine rest, on each of three targets at 100 yards. The following 30-shot averages were recorded:

	E.H.D.	E.V.D.	E.S.
Reising	7.80″	6.25″	8.03″
Thompson	9.68″	10.24″	10.94″

Ten shots were fired, semi-automatic, offhand position, on each of three targets at 50 yards. The averages were:

	E.H.D.	E.V.D.	E.S.
Reising	5.72″	8.41″	9 50″
Thompson	6.28″	9.71″	10.57″
Same conditions, 100 yards, average of five targets:			
Reising	11.72″	12.66″	15.99″
Thompson	9.82″	10.24″	12.36″

In full-automatic fire, offhand, at 50 yards, the Reising's best performance was to place three out of ten shots on a 6′ x 4′ paper. The firing was in bursts of ten rounds and in the majority of cases only the first round of each burst struck the target. The gun climbed excessively.

The Thompson consistently placed on the target from four to seven shots of each ten-round burst. Its climb was far less noticeable than that of the Reising due to better shape and more satisfactory grips.

DUST TESTS—The subject and control arms were subjected to two dust tests. In the first, road dust was thrown at the normally lubricated guns. The Thompson functioned perfectly. Some difficulty was encountered with short recoil in the first ten rounds fired from the Reising. This was due to excess friction caused by dust in the magazine and mechanism. Subsequent magazines fired without malfunction although dust still filled the mechanism.

The test was repeated by suspending the guns in an agitated mixture of sand and dry cement. The Thompson again functioned well, only one malfunction being recorded in 30 rounds. With the Reising the same difficulties were encountered as in the previous test. Sand and dust caused friction which resulted in a recoil too short to assure loading of the next round. The trouble cleared up to some extent after 20 rounds were fired.

MUD TEST—Both guns were immersed in road dust and water combined to form a thin, semi-fluid mud. If hand-loaded the Reising would fire each shot from a clean magazine. Magazines which had been in the mud bath were completely useless as the mud invariably jammed the follower. A new clean magazine would fire several rounds, then be rendered unserviceable by mud which fell into it from the gun. Firing by hand-loading was discontinued after 13 rounds due to difficulty in extracting the fired cases.

The Thompson failed to fire after the first round. Mud in the mechanism so slowed the forward stroke of the bolt that successive rounds could not be fired.

Advantages noted were that the Reising was exceedingly simple to handle, load, clean, and assemble as compared to the Thompson. Functioning under normal conditions was fairly good and with changes in design so as to prevent the easy entrance of foreign matter the gun might make a suitable military arm. The compensator used was not considered satisfactory and the use of a proven compensator would greatly improve accuracy.

Tests made of the Reising gun by the using forces resulted in considerable difference of opinion. Report 120 of the Armored Force Board, 31 October 1941, declared the Reising "superior in all respects to the Thompson. The accuracy is 15 percent greater. The gun is satisfactory for Armored Force use and the folding stock is desired. Recommend that it be adopted and that at least 1,000 be purchased for extended service test."

The report of the Infantry Board, submitted a month later, was more cautious. That Board concluded that the Reising had distinct possibilities and should be retested after the manufacturer had corrected certain minor faults. It was found that small springs and screws were easily lost, that screws worked loose during firing, that the extractor could not be cleaned in the field but required shop facilities and that the magazine "would not function under field conditions."

The Cavalry Board found the gun suitable and asked for 50 of them equipped with oiling kits. Classification as Substitute Standard was recommended.

The Reising was also tested by the Navy Department and unofficial information states that 20,000 were purchased. A large number were used by Marine forces on Guadalcanal.

SUOMI—The Suomi 9 mm submachine gun (Fig. 9), a Finnish development, was tested at Aberdeen on 18, 19, 22, 26 July and 2 August 1940. It is a straight blowback operated weapon with a selector permitting semi-automatic and full-automatic fire. The 25-round magazine is inserted from below.

Five hundred thirty-nine rounds were fired to test general functioning and to compare the performance of the Suomi with that of the Thompson, M1928A1. Those who fired the Suomi commented favorably on its performance. The Finnish weapon appeared to handle better in semi-automatic fire but was inferior to the Thompson in full-automatic. The recoil of the Suomi was less than that of the Thompson, due to the lighter cartridge, but the tendency to climb was greater. There is no muzzle brake or compensator.

The timed cyclic rate of the gun was 833 rounds per minute. The bolt does not remain open after the last round is fired.

ACCURACY—The Suomi was fired for accuracy at a range of 1,000 inches (83′ 4″) from machine rest with the following results:

ROUNDS	TYPE OF FIRE	E.H.D.	E.V.D.	E.S.
5	Semi-auto.	0.99″	1.18″	1.38″
5	Semi-auto.	0.49″	0.98″	1.00″
10	Automatic	1.05″	1.32″	1.50″
10	Automatic	0.34″	1.13″	1.22″
10	Automatic	1.11″	1.68″	1.60″

Data on the Thompson, M1928A1, at the same range reports the following:

ROUNDS	TYPE OF FIRE	AVERAGE E.H.D.	AVERAGE E.V.D.	AVERAGE E.S.
10	Semi-auto.	2.73″	1.55″	3.04″
20	Automatic	2.87″	5.17″	5.47″

In making comparisons it must be remembered that the targets were fired with ammunition of different caliber, charge, and weight.

The Suomi was also fired for accuracy at 300 yards, machine rest:

ROUNDS	E.H.D.	E.V.D.	E.S.
10	11.10″	13.55″	16.10″
10	8.50″	19.70″	19.85″
10	11.05″	18.50″	18.55″

No comparison was made with the Thompson at that range.

DUST TEST—The Suomi functioned normally after being subjected to the standard dust test. The Thompson failed to fire four of ten rounds, malfunctions being due to weak blows on the primer.

MUD TEST—Neither gun functioned after immersion in thin mud. The bolt of the Thompson would not move; the Suomi bolt moved forward slowly but with sufficient force to remove a cartridge from the magazine.

Direct comparison between the Suomi and the Thompson, M1928A1, was difficult because of the difference in calibers. The Suomi is simpler in design and may be disassembled more easily. It is slightly more effective than the Thompson under adverse conditions of dust and mud. The recoil is less because of the lighter cartridge.

The Suomi is heavier than the Thompson by .7 pound, it has a greater tendency to climb in automatic fire, and the fire control and safety latch are poorly designed.

Due to the gun's use of ammunition not standard in the U. S. Army, the Suomi was not recommended for service tests.

STAR—The Star submachine gun (Fig. 10) was designed by Sr. José Cunill de Figuerola and submitted by the Star Co. It was tested in competition with the Thompson, M1928A1, on 23, 24 August 1940.

It is a 9 mm delayed blowback weapon weighing 8 pounds, 2 ounces, and measuring 35.4 inches overall.

Fig. 9. Suomi (Finland) 9 mm.

The barrel is finned for cooling and is covered with a slotted jacket. The magazines of 10- or 30-round capacity are inserted from below. The gun is equipped with a compensator.

Two levers on the left side of the receiver control the firing rate. The forward lever may be positioned for low speed (300 rounds per minute) full-automatic fire or for single-shot operation. The rear lever has three positions: semi-automatic fire, high speed (700 rounds per minute) full-automatic, and safe.

FUNCTIONING—A total of 790 rounds was fired at semi-automatic and the two speeds of full-automatic fire. Malfunctions began to occur after 120 rounds. There were two misfires, one failure to feed, three failures to extract, three failures to eject, and on six occasions the gun fired two shots instead of one in semi-automatic fire. After 230 rounds the piece was thoroughly oiled and functioned satisfactorily, except for three misfires, during the balance of the firing.

DUST TEST—Both weapons were submitted to the standard dust test of exposure to agitated dry cement for 2½ minutes. The Thompson fired one round, the fifth, on ten attempts. The Star had four misfires and three failures to feed. Of three rounds fired, two were followed by failure to eject the case.

MUD TEST—Neither Thompson nor Star would fire after immersion in thin mud. A little water was poured into the receivers. The Thompson was not aided; the Star fired four rounds semi-automatic, then failed again.

ACCURACY—An unsuccessful attempt was made to test the Star from a machine rest at 300 yards. Three ten-shot targets were fired and only seven hits made on a 6′ x 10′ target. Five of those seven were made in one of the ten-shot series. The shots were fired from machine rest at 100 yards, semi-automatic and full-automatic. Performance was as follows:

	E.H.D.	E.V.D.	E.S.
Semi-automatic	8.16″	1.16″	11.73″
Full-automatic	9.01″	10.09″	12.73″

The various firing rates were tested on the 1,000-inch range from machine rest as follows:

	E.H.D.	E.V.D.	E.S.
Average of 30 shots	2.28″	2.42″	2.84″
Retarded auto	2.91″	3.14″	3.58″
Full-automatic	4.09″	1.94″	4.00″

GENERAL OBSERVATIONS—Muzzle flash was very noticeable with the Star gun and sparks were observed at the breech and around the bolt. This may have been due to the ammunition or to an oversized chamber. Recoil was very light and there was little or no tendency to climb. The gun functioned poorly unless properly lubricated.

The only advantages over the Thompson were those of 1.55 pounds lighter weight and the fact that the forward motion of the bolt does not tend to throw the sight off the target as with the Thompson.

The gun was not recommended for service tests.

ATMED—This weapon (Fig. 11) was designed by George J. Hyde and submitted by Atmed Manufacturing Co. It is a caliber .45 weapon weighing 9.48 pounds and operating on the straight blowback principle. No compensator or muzzle brake is used. The 11.5-inch barrel is provided with cooling fins. A lever on the left side of the trigger guard may be positioned for safety, full-automatic, and semi-automatic fire. The Atmed was tested at Aberdeen Proving Ground on 3, 7 September 1940.

The Atmed is designed on the Becker principle, in which the cartridge is ignited before the heavy bolt has ceased its forward motion. This serves to dampen recoil but when ignition is too early pressure is lost and the bolt fails to recoil a sufficient distance to pick up and chamber another round. When first tested, the gun functioned very poorly with Frankford Arsenal ammunition, repeated jams being caused by primers which had been punched completely from their cases. Somewhat more satisfactory functioning was obtained with commercial ammunition and the difficulty virtually disappeared when the firing pin was shortened .009 inch, permitting a further forward travel of the bolt before ignition of the cartridge.

Fig. 10. Star, 9 mm.

Fig. 11. Atmed.

A weak sear bar spring was judged to be the cause of erratic performance in semi-automatic fire. At times the gun failed to fire, at other times it would fire doublets and triplets when the trigger was depressed. Shortening of the driving spring by 1⅜ inches failed to correct this fault.

Forty rounds were fired from the Atmed and the Thompson, M1928A1, to determine relative handling qualities. The Atmed was superior. It could be operated easily with one hand in full-automatic fire without objectionable recoil or tendency to climb.

Cleaned of all oil (dry test) the Atmed functioned normally in full-automatic fire but would not function semi-automatically.

DUST TEST—The Atmed and Thompson, M1928A1, were suspended in a closed container and exposed to agitated cement for 2½ minutes. Atmed functioned normally in full-automatic fire but continued to fire two or more shots in semi-automatic operation. In twenty attempts made to fire the Thompson, three cartridges fired but in each case the weapon failed to feed a new round.

MUD TEST—The two guns were submerged in a mixture of road dust and water, then removed and fired. The Thompson failed to function. The Atmed functioned normally in both full- and semi-automatic fire except for one failure to feed. It was the first gun to pass the mud test successfully.

ACCURACY TESTS—Twelve groups of ten shots were fired at a range of 1,000 inches (83′ 4″) from a machine rest.

	E.H.D.	E.V.D.	E.S.	
Atmed	0.94″	1.45″	1.66″	(Semi-auto. Average 5 targets)
Atmed	1.15″	1.25″	1.66″	(Full-auto. Average of 7 targets.)
Thompson	2.73″	1.55″	3.04″	(Semi-auto. Average of 5 targets.)
Thompson	2.87″	5.17″	5.47″	(Auto. Average of 7 targets.)

The Atmed was tested from a machine rest at 100 yards. Ten shots were fired on each of three targets at semi- and full-automatic fire with the following results:

	E.H.D.	E.V.D.	E.S.	
Average of 30 shots	3.15″	3.92″	4.33″	semi-auto.
	3.05″	7.47″	7.60″	full-auto.

Tests made of the Atmed at a range of 300 yards, from machine rest, were as follows:

	E.H.D.	E.V.D.	E.S.
Average of 30 shots, semi-auto. fire	18.47″	35.39″	35.47″
Average of 19 shots, full-auto. fire	14.40″	28.99″	29.78″

At a range of approximately 40 yards an expert rifleman placed 25 shots from the Atmed within a one-foot circle, firing full-automatic. Another rifleman did nearly as well after firing a few rounds to get the "feel" of the weapon.

The Atmed was not given service tests.

HI-STANDARD—The first model of the Hi-Standard submachine gun was inspected and informally tested at Aberdeen Proving Ground on 28 and 29 August 1940. It was a cal. .45 weapon weighing 8.75 pounds and measuring 33.1 inches overall.

In the functioning tests the Hi-Standard handled more easily than the Thompson, M1928A1, and was of simpler construction. The cyclic rate of 900 rounds per minute was high and there was no provision for a magazine of more than 20 rounds capacity.

Further tests were recommended and the gun was returned to the manufacturers who submitted a second model (Fig. 12) on 12 November 1941. The gun was formally tested at Aberdeen Proving Ground on 24 and 26 November 1941. A 40-round magazine accompanied the weapon but could not be used because the forestock had been moved about 1.5 inches to the rear to provide a more convenient grip in prone firing. The average cyclic rate—880 rounds per minute—was only slightly lower than that of the earlier model.

Fired for accuracy from a machine rest at 100 yards the Hi-Standard showed the following average dispersion for ten shots on each of three targets:

	E.H.D.	E.V.D.	E.S.
Semi-automatic fire	5.38″	6.37″	6.67″
Full-automatic fire	5.27″	6.28″	6.97″

Those figures compare favorably with the extreme spread of 10.56 inches and 10.93 inches obtained with the Thompson, M1928A1, in semi-automatic and full-automatic fire at the same range. The figures are given only for comparison. The guns were not fired in competition one with the other.

Accuracy in semi-automatic fire was tested from the offhand position. Ten shots were fired at each of

Fig. 12. Hi-Standard.

five targets at 100 yards. Analysis of the 50 shots showed:

	E.H.D.	E.V.D.	E.S.
Hi-Standard	11.10″	15.60″	17.30″
Thompson, M1928A1	9.82″	10.24″	12.36″

Ten shots were fired offhand at each of ten targets at 50 yards. The Hi-Standard consistently placed from four to nine shots of each burst on the 6′ x 6′ target and was reported to handle comparatively well. The Thompson averages from three to seven hits under similar conditions.

DUST TEST—The Hi-Standard functioned perfectly after being exposed to agitated dry cement in a closed container. Both dusty and clean magazines were used and the gun handled both equally well.

MUD TEST—The gun fired three rounds after immersion in thin mud, then functioned faultily. Because of the large amount of grit which had penetrated to the chamber the bolt either failed to close or—if it closed sufficiently to fire the round—failed to eject the fired case. The chamber was cleaned and a full 20-round magazine was fired without malfunction. The Thompson could not be fired after immersion in mud.

Conclusions reached as a result of the tests of the Hi-Standard gun were that its accuracy from machine rest was good in comparison with the Thompson, M1928A1; its accuracy from the offhand position, full-automatic, was very good in comparison with the Thompson, M1928A1, and excellent in comparison with the Reising gun. Accuracy was rather poor when fired offhand, semi-automatic. The gun's functioning was excellent under adverse dust conditions, good under excessive mud.

General functioning was good. The only common malfunction was that of firing doublets in semi-automatic operation. This appeared to be due to the rather inferior quality of the sear spring which took a permanent set after several hundred rounds. The gun was well balanced and well made. The recoil was light and there was little tendency to climb in full-automatic fire. No muzzle brake was used.

Fig. 13. Woodhull.

Six Hi-Standard guns were distributed among the Infantry Board, Cavalry Board, and Armored Force Board. Limited service tests indicated that further development was necessary before the weapon would meet the requirements of those Arms. The classification of the M2 as Substitute Standard halted further tests of the Hi-Standard gun.

WOODHULL—The Woodhull Corporation submitted their first weapon for tests as a carbine (O.P. 4972). This was a caliber .30 weapon built on the frame of the Winchester Model 1907 self-loading rifle, cal. .351.

In building a submachine gun, the makers used the heavier frame of the Winchester Model 1910 self-loading rifle, chambered commercially for the caliber .401 cartridge. The caliber was increased to .45 and provision made for a 10-round magazine, inserted from below. This gun is illustrated in Fig. 13.

Woodhull adaptation of the Winchester self-loading mechanism to full-automatic fire necessitated an extremely complicated fire selector, difficult to dismount or assemble. It cannot be changed from the semi-automatic to the full-automatic position unless the bolt is retracted.

The gun has a straight blowback action; a compensator is used, and the barrel is finned for cooling.

The gun was tested for accuracy, general functioning, and functioning under adverse conditions on 15, 16 January 1942. A total of 413 rounds was fired.

ACCURACY—The following results were obtained when ten shots, semi-automatic and full-automatic, were fired from machine rest on each of three targets at 100 yards.

	E.H.D.	E.V.D.	E.S.
Full-automatic fire	5.07″	6.32″	6.72″
Semi-automatic fire	3.24″	6.95″	7.10″

This accuracy is good in comparison with the Thompson, M1928A1, the extreme spreads of which in full-automatic and semi-automatic fire are 10.93 inches and 10.56 inches.

In full-automatic fire from the offhand position, 50-yard range, ten groups of ten shots each were fired at the 6′ x 6′ target. The Woodhull placed from four shots to all ten of each burst on the target. The Thompson, M1928A1, under similar conditions, consistently scored from seven to ten hits.

Ten shots were fired on each of five targets at 100 yards, offhand position, semi-automatic fire for the following averages:

	E.H.D.	E.V.D.	E.S.
Woodhull	12.24″	11.28″	13.81″
Thompson	9.82″	10.24″	12.36″

The two weapons compare favorably in semi-automatic performance.

General functioning of the Woodhull was good, the only malfunctions being four failures to feed in 413 rounds fired. All those could be definitely blamed upon the magazine which is of the single column type and easily put out of action by grit or any deformation of the walls. It was found that the magazine could be pushed so far into the receiver as to prevent the bolt from closing. During the test one magazine was withdrawn as unserviceable.

The report of the gun was particularly severe.

The cyclic rate was approximately 750 rounds per minute, that of the Thompson is 610 rounds per minute.

Dust Test—The gun fired 30 rounds without incident after being subjected to the standard dust test. One malfunction occurred with the Thompson, M1928A1.

Mud Test—The Woodhull would not function after immersion in thin mud, although single rounds could be fired if inserted by hand and the bolt forced home upon them. Mud rendered the fire-selector lever completely inoperative, and penetrated freely into the mechanism. A small quantity of mud rendered the magazine useless, the follower failing to raise the uppermost cartridge to a position where it could be picked up by the bolt.

The Thompson failed to function.

Conclusions—The Woodhull was a well-made and well-finished weapon but in certain details extremely complicated and not adaptable to quantity production. The excessively loud report was objectionable. The magazines as designed were not suited for rapid charging and were liable to cause malfunctions. The operation was poor under extreme conditions of mud. (The Thompson, M1928A1, is very poor.) No recommendations for further tests were made.

STEN, MK. II—This 9 mm, 7.19-pound weapon (Fig. 14) is a British development and is the standard submachine gun of the British armies. The Mk. I, Mk. II, and Mk. III Sten guns differ only in minor details. All are straight blowback weapons with 30-round magazines feeding from the left side. The firing pin and bolt are integral and the cartridge is picked up, chambered, and fired on the closing stroke.

Tests of many submachine guns at Aberdeen Proving Ground indicated that the side-feeding magazine is not a desirable feature on weapons of this type. The

Fig. 14. Sten (England) 9 mm.

weight of the full magazine imparts considerable torsional strain upon the forward hand and some operators have noticed a disturbance of aim due to a shifting center of gravity as the magazine is fired. The operating spring of the Sten is exposed for the greater part of its length by the open slot in which the operating knob travels. Foreign material can enter the mechanism. There is no safety and—since the bolt cannot be locked—the weapon may be accidentally discharged. Such discharge may occur with the bolt closed if the gun is dropped or the buttplate struck sharply against some solid object.

The Sten is equipped with a selector lever, mounted on the right side of the receiver, permitting full-automatic or semi-automatic fire.

The gun was tested for accuracy, endurance, and general functioning on 23 January 1942. Further tests under adverse conditions of mud and dust and of extreme cold were made on 29 September 1942.

Accuracy—The following averages were recorded for 30 shots fired full- and semi-automatic from machine rest on three targets at 100 yards.

	E.H.D.	E.V.D.	E.S.
Automatic	6.08″	4.29″	6.18″
Semi-automatic	4.52″	4.97″	5.84″

This accuracy was excellent in comparison with the Thompson, M1928A1, which averages an extreme spread of 10.93 inches, in full-automatic fire, 10.56 inches in semi-automatic fire under the same conditions.

Ten shots were fired on each of ten targets at 50 yards from the offhand position. The Sten—a 9 mm weapon—placed 79 of 100 shots on a 5′ x 6′ target. The Thompson averages 49 out of 100.

In semi-automatic fire, offhand, at 50 yards, the two guns recorded the following average dispersion of ten shots on each of five targets:

	E.H.D.	E.V.D.	E.S.
Sten	13.7″	13.6″	16.6″
Thompson	9.82″	10.24″	12.36″

The consensus of the operators was that the discrepancy between the two guns was largely due to the

Fig. 15. Masco.

awkward manner in which the Sten must be held. The grip for the right hand is extremely uncomfortable; the left hand must either grip the side-mounted magazine or occupy a position immediately in front of the trigger guard.

Dust Test—Excessive dust had little or no effect upon the Sten. After the first test, 30 rounds fired normally with both clean and dirty magazines. After the second exposure to dust, the Sten fired 30 rounds from a clean magazine without incident. A dusty magazine fired three rounds before the follower jammed.

Mud Test—When first tested, the Sten failed to function due to mud filling the recess in the bolt and preventing its motion. After cleaning, it functioned normally. In the second test the bolt closed very slowly. Three rounds were fired before the magazine follower jammed. The trigger mechanism was found full of mud which also filled the receiver.

Cold Test—The Sten was one of two submachine guns subjected to this test. The gun was cleaned, oiled and wiped dry, then held for 23 hours at a temperature of −40° F. Two 20-round magazines were then fired. One light firing pin blow was recorded. The timed cyclic rate averaged 525 rounds per minute, slightly below the normal rate of 560 rounds per minute. No cold test of the Thompson, M1928A1, was reported.

Rain Test—The gun was exposed for an unstated period to both direct stream and heavy spray from a hose, simulating conditions to be expected in tropical warfare.

Two hundred rounds were then fired with four failures to eject. These were due to the combination of a short ejector and the "sloppy" tolerance in bolt fit general in weapons of this type. All cases were extracted but at times the ejector merely grazed the extracted shell and the force was not sufficient to throw it clear of the gun.

The test indicated that weapons of the straight blowback type, without camming surfaces in the action, would function indefinitely under conditions of heavy rain.

Endurance—Seven hundred and twenty rounds were fired with two failures to feed and twelve failures to eject. The ejection malfunctions were from the same cause as those in the rain test.

MASCO—A submachine gun (Fig. 15) manufactured by the Masco Ordnance Corporation was shipped to Aberdeen Proving Ground early in April, 1942, with the request that it be fired not more than 200 rounds and that a brief and informal report of its merit be sent the inventor. It was a caliber .45 weapon, blowback operated. The semi-automatic fire control was admittedly inoperative and the gun had no sights. After improvised sights were mounted, 100 rounds were fired at the standard 6′ x 6′ target at 50 yards, offhand. Fifty-seven hits were recorded with the following dispersion:

	E.H.D.	E.V.D.	E.S.
Average	37.91″	67.82″	54.45″

No descriptive record of the weapon was made nor were additional tests attempted. The informal report stated that it was "entirely unfit for military use."

The gun was returned to its maker.

MODIFICATIONS OF U. S. PISTOL, CAL. .45, M1911A1—Consideration was given to two modifications of the standard caliber .45 pistol to convert it to a submachine gun. A modification submitted by Mr. Frank Bielaski was demonstrated to the Chief of Infantry and at his suggestion tested by the Infantry Board to determine its suitability for use by parachute troops. A report upon these tests was to the effect that the modified pistol was greatly inferior to the U. S. Carbine, M1, as an auxiliary weapon for infantry and that a carbine with a folding or collapsible stock would meet more nearly the requirements of parachute troops.

Fig. 16. Colt Pistol, M1911A1, converted to submachine gun.

The modification submitted by the Colt Patent Firearms Co. is illustrated in Fig. 16. Barrel length is increased to approximately 9.5 inches and a perforated sleeve is added to facilitate cooling. The long magazine (20 rounds) is carried in a recess in the extension stock when not in use. The meager and informal report upon this weapon does not state whether any modification of the disconnector of the M1911A1 pistol was made to permit full-automatic fire, nor is the method of attaching the stock described.

It is apparent from the illustration that an operator firing the weapon from the shoulder would be in extreme danger of being struck by the recoiling slide. Equally apparent is the fact that the low mounting of the stock would result in excessive climb under full-automatic fire.

The Ordnance subcommittee recommended (28 May, 1942) that development of such modifications of the Standard pistol be discontinued.

TURNER—This caliber .45 weapon (Fig. 17) was the only gas-operated submachine gun submitted. Since the Ordnance Department was eager to explore the possibilities of this design in a submachine gun, the Turner was given the standard test at Aberdeen Proving Ground on 26, 28 August 1942.

GENERAL OBSERVATIONS—The Turner is an extremely lightweight (5.32 pounds without magazine) gas-operated weapon firing the caliber .45, M1911, cartridge from a 20-round magazine inserted from below.

The gas is taken off from a port on the left side of the barrel a short distance ahead of the chamber. The gas chamber and piston are exposed and present a decided hazard. It would be easy for the fingers of the operator's extended hand to be caught by the moving parts.

Fig. 17. Turner gas-operated gun. Note exposed piston.

The bolt-retracting handle is an integral part of the piston and firing causes it to overheat excessively. Another source of excessive heating is found in the rivets with which the forestock band is attached. Several operators burned their fingers severely.

The bolt fails to remain open after the last shot is fired.

ENDURANCE—A total of 5,500 rounds was fired in order to test thoroughly the design and functioning as well as the accuracy of the gas-operated gun. Sixteen failures to feed were caused by the nose of the bullet striking the ramp and failing to enter the chamber. A slight bevel was filed on the ramp and about 1/12 inch filed from the buffer block and the end of the driving spring guide rod. Approximately 1/32 inch was ground from the end of the piston to increase the capacity of the gas chamber. Those changes, made in the course of the endurance test, greatly reduced feeding malfunctions.

The magazines were a source of considerable trouble. These are of the staggered column type in the body, tapering to single column in the throat. They are undoubtedly Harrington & Richardson magazines, reworked to adapt them to the Turner gun. The reworked lips failed to hold the cartridges securely. If a magazine were dropped, all the cartridges it contained would be thrown out. During the firing it was frequently necessary to bend the magazine lips back into shape.

Fire control was not reliable—doublets, triplets, and even short bursts being delivered during semi-automatic fire. This trouble was virtually eliminated by stoning the edge of the disconnector so as to give it a slight radius at the point where it met the sear.

The following malfunctions were recorded after corrections of the difficulties mentioned.

Failure to feed (cartridge tipped)	6
Failure to feed (fault in magazine)	2
Misfire (tried three times—presumably defective primer)	1
Light firing-pin blows	2
Failure to eject	2
Doublets in semi-automatic fire	2
Failure of bolt to close	2

A failure of the bolt to close at round 5,460 chipped a piece from the rim of the bolt. The broken fragment stopped the action but after it was removed the gun finished the endurance, mud, and dust tests.

The operating spring guide rod and two firing pins broke in the course of the tests, which revealed that the pins were too long and too narrow, resulting in many pierced primers. The actual breakages were the

result of attempting to fit a tapered firing pin in a straight hole in the bolt. The tests were discontinued until new pins were obtained and the straight-drilled hole properly tapered. The new pins were shorter and of larger diameter at the head. There were no more pierced primers.

ACCURACY—Ten rounds fired from machine rest on each of three targets at 100 yards.

	E.H.D.	E.V.D.	E.S.
Average (full-auto.)	8.04″	8.93″	10.08″
Average (semi-auto.)	8.91″	8.73″	10.03″

Ten shots were then fired offhand, semi-automatic, on ten targets at 100 yards.

	E.H.D.	E.V.D.	E.S.
Average of 100 shots	17.33″	16.33″	20.96″

In full-automatic fire, offhand position, 50 yards range, the gun placed 56 of 100 shots on the 6′ x 6′ target. The recoil was severe in comparison with other submachine guns and the tendency to climb was excessive. Those shortcomings were due to the light weight of the piece and the high cyclic rate, the average of 67 timed bursts being 1,483 rounds per minute. The cyclic rate was erratic as well, varying from 1,282 to 1,655 rounds per minute.

Accuracy in full-automatic fire, offhand, was poor as compared to that of the M1 and M2. Accuracy from machine rest was equal to the M1 and better than the M2.

DUST TEST—The Turner failed to fire a dusted magazine, the follower jamming and refusing to feed. A considerable quantity of dust was found in the action when the gun was cleaned. When a clean magazine was inserted, four light firing-pin blows were recorded in 20 rounds fired.

MUD TEST—The gun would not fire from a muddy magazine, and continued refusal when a clean magazine was inserted. The malfunctions of the 20 rounds attempted included eight light firing-pin blows, six failures to feed, and six failures of the bolt to close.

The general functioning was good, but inferior to both the M1 and M2.

The gun was inferior to the M1 and M2 under excessive dust and would not function under excessive mud.

The extremely high cyclic rate was objectionable.

Considerable carbon escaped from the gas port, blackening the operator's trigger-hand.

The gun was not recommended for further tests.

ATLANTIC—The Atlantic submachine gun (Fig. 18) was a delayed blowback weapon chambered for the caliber .38 automatic Colt pistol cartridge. It was designed by Sr. José Cunill de Figuerola, designer of the 9 mm Star gun, and was compared with that arm rather than the Thompson, M1928A1. Tests were made on 28 and 29 August 1942.

The gun was similar in appearance to the Star and incorporated only slight modifications of that weapon. The Star's full-automatic bar, completely depressing the sear, had been eliminated, permitting automatic fire only at a retarded rate. The average cyclic rate was 508 rounds per minute. The Star had a high speed rate of 700 rounds per minute and a retarded rate of 300 rounds. The trigger mechanism of the Star had been simplified in the Atlantic and the magazine catch improved so as to prevent accidental release of the magazine. A foregrip, absent from the Star, appeared on the Atlantic.

ACCURACY—Ten rounds were fired from machine rest, full- and semi-automatic, on each of three targets at 100 yards.

	E.H.D.	E.V.D.	E.S.
Average (full-auto.)	9.75″	6.82″	11.33″
Average (semi-auto.)	6.17″	6.04″	7.70″

At 50 yards, in full-automatic fire from the offhand position, the Atlantic placed 77 out of 100 shots upon the 6′ x 6′ target. The recoil and stability were considered fair but not so good as in other submachine guns tested and markedly inferior to the M2.

At 100 yards, offhand, semi-automatic, the following averages were recorded for 100 shots.

E.H.D.	E.V.D.	E.S.
15.89″	17.14″	20.20″

It was necessary to load single rounds in all test of semi-automatic fire, the weapon failing to function reliably with the selector in that position. Doublets, triplets and short bursts were caused by the failure of the trigger to operate. Rate of full-automatic fire was erratic. Those malfunctions were not recorded for the Star gun.

Fig. 18. Atlantic, Cal. .38 A.C.P.

DUST TEST—The gun fired a clean 30-round magazine without incident. One failure to extract and three failures to fire were recorded when a dusted magazine was inserted.

MUD TEST—The gun could not be fired with a muddy magazine. The first round from a clean magazine fired; the remaining rounds would not feed.

The Atlantic demonstrated no particular improvement over the Star gun and was inferior to that weapon in several respects. It was inferior to the M2 in accuracy and in general functioning. In addition, it was chambered for the non-standard caliber .38 automatic Colt pistol cartridge.

The recommendation was that no further consideration be given the weapon.

AUTO-ORDNANCE, T2—The gun so designated was manufactured by the Auto Ordnance Company, makers of the Thompson gun, but announced as differing entirely in design from its previous products. Tests were completed at Aberdeen Proving Ground on 11 September 1942. The weapon is illustrated in Fig. 19.

In competition with the M2, the new gun was found superior only in the mud test. The T2 was operative after immersion in thin mud, while the M2 refused to function after such immersion. The average cyclic rate of the T2 was 600 rounds per minute, that of the M2, 527 rounds. Both weapons were stable under full-automatic fire, but the performance of the M2 was superior.

The selector for full-automatic and semi-automatic fire as supplied on the T2 was neither positive nor reliable and Aberdeen testers expressed the belief that the weapon would be rejected by the using services for that reason. Accuracy under full-automatic fire was not equal to that of the M2 which scored 99 hits out of 100 shots upon a 6′ x 6′ target as against 80 hits for the T2. The range at which the tests were fired was not specified but presumably was 50 yards.

In the course of the tests the T2 developed 60 stoppages and two breakages as compared with two stoppages and no breakages for the M2. It should be mentioned that 37 stoppages of the T2 were attributable to a cracked trigger housing which developed after the firing of 750 rounds.

The Ordnance Committee recommended that no further consideration be given the T2.

AUSTEN, MK. I—This 9 mm gun (Fig. 20) is the Australian version of the British Sten and is very similar to that weapon. It is equipped with a foregrip, lacking on the Sten, and a folding stock. The bolt-operating handle, instead of being detachable like that of the Sten, is integral with the bolt. The bolt slot is extended through the receiver to permit the bolt to be withdrawn in disassembly.

In the standard submachine gun test at Aberdeen on 25–27 November 1942 the Austen gave a very satisfactory performance, as did the majority of the 9 mm weapons tested. The general functioning was considered excellent except for recurrent doublets in semi-automatic fire.

ACCURACY—From machine rest at 100 yards, ten shots on each of three targets showed the following averages:

	E.H.D.	E.V.D.	E.S.
Semi-automatic	11.06″	10.49″	12.72″
Full-automatic	9.86″	12.09″	13.10″

In offhand full-automatic fire at 50 yards the Austen placed 98 of 100 shots on the 6′ x 6′ target. The gun was very stable and showed no tendency to climb.

The average of 100 shots, semi-automatic, fired offhand at 100 yards, was as follows:

E.H.D.	E.V.D.	E.S.
21.95″	19.89″	27.74″

ENDURANCE TESTS—Only one malfunction—a light firing pin blow—occurred during the firing of 2,500 rounds full-automatic. The average cyclic rate recorded was 575 rounds per minute and the gun was not oiled during the firing.

There were 75 doublets recorded during the firing of 2,500 rounds semi-automatic but only one malfunction, a failure to eject.

Fig. 19. Auto-Ordnance, T2.

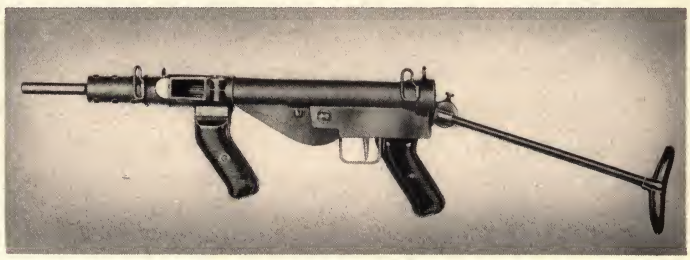

Fig. 20. Austen (Australia) 9 mm.

The gun's performance in those tests was excellent.

DUST TEST—After exposure to dust for 2½ minutes the Austen fired only one round from a dusted magazine before the carrier jammed. A clean magazine fired without incident.

MUD TEST—The gun would not fire with a muddy magazine, the dirty cartridges failing to seat in the chamber. A clean magazine was inserted and 30 rounds fired with one light blow recorded.

UNITED DEFENSE—A submachine gun submitted by the United Defense Corporation was inspected and tested informally at Aberdeen Proving Ground on 2 April 1943. It is illustrated in Fig. 21. This U.D.–1 was a "convertible" 9 mm/cal. .45 weapon, being adaptable to either cartridge by changing barrels. No change of bolt was necessary. The barrel not in use screwed into a hinged fitting on the left side of the piece above the pistol grip and could be swung to the rear to serve as an extension stock. The position of the pistol grip and the hinged fitting tended to pinch the gunner's thumb.

The gun was of the straight blowback type, equipped with a bayonet, and had a selector on the right side of the receiver with positions for safety, semi-automatic fire, and full-automatic fire. There was no satisfactory method of locking the closed bolt. During the test the bolt was closed and the selector placed on safety. The piece was then jarred sharply against a table. The bolt locked and the safety jammed. It was necessary to remove the sideplate before the safety could be released.

The gun was not given the complete standard test. A total of 180 rounds of caliber .45 ammunition was fired to test functioning under normal and adverse conditions and the performance of the weapon did not warrant an accuracy test. One failure to extract was recorded during the firing. The average cyclic rate was 1,150 rounds per minute which produced a decided tendency to climb. No tests were made with 9 mm ammunition.

Fig. 21. United Defense.

Fig. 22. Owen.

DUST TEST—After exposure to dust and with a dusty magazine in place the gun fired 20 rounds without incident. A clean magazine was substituted and one failure to feed recorded in the 20 rounds fired. Little dust entered the mechanism.

MUD TEST—The gun refused to fire after the standard mud test. Company representatives expressed the opinion that the failure might be due to mud entering holes in the magazine walls. The weapon was cleaned, the holes covered with Scotch tape, and the mud test repeated. The gun again failed. Mud appeared to penetrate to the bolt and bolt face by working up the magazine well.

No further consideration of the United Defense gun was recommended.

OWEN—Designed by Lieutenant Evelyn Owen of the Australian Army, this gun (Fig. 22) is manufactured in Australia and is standard equipment for the forces of that commonwealth. It weighs 10.04 pounds, operates on the straight blowback principle, and fires the standard 9 mm British Parabellum cartridge from a 33-round magazine. The magazine feeds from the top and the sights are offset to the right to avoid interference by the rectangular magazine housing.

Fired cases are ejected from below, a decidedly unusual feature being that the ejector is an integral part of the magazine.

Cooling fins are machined on the barrel and the gun is fitted with a compensator. Semi-automatic and full-automatic fire are controlled by a change lever on the left side just above the trigger. When moved to the "Safe" position the change lever blocks the trigger.

The Owen was tested at Aberdeen Proving Ground on 1–4 May 1943 and was rated "good" in accuracy and "excellent" in general functioning, in functioning

under the adverse conditions of dust and mud, and in general endurance. One round in 30 fired from a dusted magazine failed to feed due to the magazine follower sticking. There were no malfunctions after the standard mud test.

Two hundred rounds—40 of them in full-automatic fire—were fired after the gun had been thoroughly sprayed to simulate heavy rain. The weapon functioned perfectly.

ACCURACY—100 yards, machine rest, ten shots on each of three targets at semi-automatic fire, ten shots on three targets at full-automatic fire.

	E.H.D.	E.V.D.	E.S.
Semi-automatic	6.22″	7.93″	8.65″
Full-automatic	7.20″	7.64″	10.28″
Offhand position, semi-automatic fire, average of 100 shots	15.16″	16.12″	19.26″

In full-automatic fire, offhand, at 50 yards, the Owen scored 89 hits out of 100 rounds fired on the standard 6′ x 6′ target. All accuracy tests in the offhand position were fired by several gunners of various degrees of skill. Recoil was light and there was little tendency of the weapon to climb.

The fact that 9 mm ammunition was used throughout the test must be considered in any comparison of the Owen with caliber .45 weapons.

Fig. 23. Olsen.

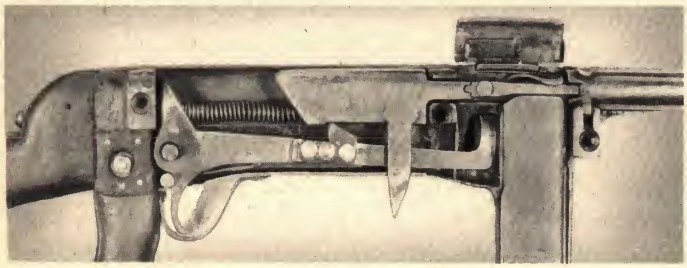

Fig. 24. Olsen, side plate removed. Note position of bolt.

OLSEN—The Olsen submachine gun (Figs. 23 and 24) was submitted by A. W. Olsen, its designer, and H. J. Fitzgerald. It is a caliber .45 straight blowback weapon weighing 9.22 pounds with empty 20-round magazine in place. Fig. 24 shows the receiver of the weapon with the side-plate removed to show the extremely light bolt and the unusual curved lip at the top of the magazine. This lip permits the rounds to rise directly into the path of the bolt rather than to be picked up by the bolt on its forward stroke. The result is that the bolt on its forward stroke blocks the magazine and prevents its withdrawal in the event of a malfunction.

Full-automatic fire is obtained by simultaneous pressure upon the trigger and an auxiliary button on the left side of the stock. Semi-automatic fire can be obtained only by depressing and releasing the button, then pulling the trigger. That confusing two-finger process must be repeated for each shot fired. The button is located on the left side of the receiver, immediately behind the trigger, and is within reach of the operator's right thumb as he grasps the pistol grip. Its operation is virtually impossible without releasing or shifting the normal hold upon the piece.

The Olsen gun was tested at Aberdeen Proving Ground on 2 June 1943 and its performance compared with that of the M3. A total of 240 rounds was fired to observe general functioning.

The cyclic rate of 1,111 rounds per minute was very high for weapons of this type and the recoil was characterized as "very severe." There was a marked tendency to climb under full-automatic fire. Trigger vibration was so excessive as to produce soreness of the gunner's finger. Changing of the magazines was slow and laborious.

The weapon performed satisfactorily under the dust test but failed to fire with either clean or dirty magazines after the standard mud test. The inventor fired two targets, full-automatic fire, at 100 yards. The first burst was directed at a 10-inch bull in the middle of a 6′ x 6′ target. Only 5 of the 20 shots hit the paper, none entering the bull. The dispersion covered approximately 5′ x 2′. The second burst of 20 rounds was fired at a 14′ x 14′ target. None of the shots struck the mark and the test was halted at that point. The conclusion reached was that the Olsen was far inferior to the M3 and no further action was recommended.

SCHMEISSER, M.P.40—This weapon is the standard "machine pistol" of the Reichswehr infantry, para-

chute troops, and other shock units. It is carried by motorcyclists and as an auxiliary arm in tanks and for the crews of armored vehicles. The designation M.P.40—"Maschinenpistole 40"—indicates the year, 1940, in which the present model was adopted.

The Schmeisser is a straight blowback weapon weighing 8.87 pounds with empty magazine and firing the standard 9 mm Parabellum cartridge from a 32-round box magazine inserted from below. Its overall length with stock extended is 35 inches, reduced to 24.5 inches by folding the stock. There is no provision for semi-automatic fire and the cyclic rate, full-automatic, as timed at Aberdeen Proving Ground, is 518 rounds per minute.

For purposes of comparison with our own and other weapons, the Schmeisser was given the standard submachine gun test at Aberdeen Proving Ground between 30 December 1942 and 14 January 1943. U. S. commercial (Winchester) cartridges were used and a total of 5,723 rounds was fired.

Accuracy—Ten shots were fired, full-automatic, from machine rest on each of three targets at 100 yards. Averages recorded for the 30 shots were:

E.H.D.	E.V.D.	E.S.
6.75″	5.21″	8.05″

The Schmeisser was not fired in actual competition with the U. S. Submachine Gun, M3, but for purposes of comparison the following 30-shot averages are given for the U. S. weapon in both caliber .45 and 9 mm.

	E.H.D.	E.V.D.	E.S.
Cal. .45	7.55″	5.65″	8.45″
Cal. 9 mm	7.63″	5.65″	8.44″

In semi-automatic fire, under the same conditions, the following averages were recorded for 30 shots with the Schmeisser gun. The performance of the M3 is again shown for comparison.

	E.H.D.	E.V.D.	E.S.
Schmeisser, 9 mm	8.76″	6.57″	9.00″
M3, cal. .45	7.19″	7.61″	9.36″
M3, cal. 9 mm	7.04″	6.04″	7.06″

The Schmeisser placed 81 of 100 shots on the standard 6′ x 6′ target at 50 yards when fired full automatic from the offhand position. The M3, in either caliber, consistently averages from 92 to 98 hits in this type of fire. The testers of the German weapon noted, however, that the lock on the folding stock of the test gun was so worn as to permit considerable play between the stock and the gun. It was felt that the Schmeisser was actually more accurate than was indicated by the test. The firing rate was regular and there was no excessive tendency of the gun to climb.

Fig. 25. Schmeisser (Germany) 9 mm.

In semi-automatic fire, offhand, 78 hits were obtained in firing 100 shots at the 6′ x 6′ target at a range of 100 yards. The firers reported that the comparatively high cyclic rate (518 rounds per minute) of the weapon and the absence of a fire selector made single-shot firing almost impossible.

Endurance—A total of 5,500 rounds was fired in the endurance test. No breakages occurred and there were only five malfunctions—three failures to feed, one light firing-pin blow, and one failure to eject.

In the course of the endurance firing it was discovered that vibration of the weapon had a tendency to loosen the receiver lock, permitting partial rotation of the receiver as in the disassembly operation. The condition was encountered several times during the test firing and in each instance resulted in a "runaway gun," the sear being held down and fire continuing until the magazine was emptied.

Dust Test—The Schmeisser was subjected to the standard dust test and failed to feed the ninth round when the follower of a dusted magazine jammed. A clean magazine was inserted and the gun functioned normally. Its performance in this test was judged excellent although it was noted that the magazines were sensitive to dust or grit.

Mud Test—The gun failed to function with either clean or muddy magazines after being subjected to the standard mud test. It was found that mud and grit penetrated the receiver and jammed the telescoping sections of the driving spring housing. The gun had to be disassembled and cleaned before firing could continue.

Conclusions—It was concluded that the general functioning of the Schmeisser was excellent and that its accuracy was very good. Disassembly and assembly were considerably more complicated than with the M3 and could not be accomplished without tools. On a basis of 100 the Schmeisser was given a rating of 79 as compared with the 95 rating accorded the U. S. Submachine Gun, cal. .45, M3.

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137 —9/11/40	Star
138 —9/23/40	Hi-Standard
141 —10/11/40	Atmed
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174 —11/25/41	Reising
176 —12/10/41	Hi-Standard
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181 —1/23/42	Sten, Mk. II
183 —2/2/42	Woodhull
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197 —5/20/42	Hyde Inland (M2)
199 —4/18/42	Thompson Improved Model
199½—4/11/42	Masco
205 —6/1/42	M1928A1 Thompson
208 —7/16/42	M2
222 —9/29/42	Sten, Mk. II
223 —10/1/42	Sten, Mk. III
224 —9/28/42	Thompson, M1 (modified)
225 —10/9/42	M1
226 —10/13/42	T2 (Auto Ordnance)
228 —10/10/42	Atlantic
229 —10/16/42	Turner
231 —11/24/42	T20 (M3)
234 —12/24/42	Austen
237 —4/10/43	Second Summary Report
255 —4/10/43	United Defense 1
260 —6/19/43	Owen
P. R. 14, O. P. 5826	Schmeisser (German) M.P. 40
FM 23–25	Pistol, Cal. .45, M1911A1
TM 9–1925	Pistol, Cal. .45, M1911A1
FM 23–40	Submachine Gun, Thompson, M1928A1
TM 9–215	Submachine Gun, Thompson, M1
TM 9–2005	Ordnance Matériel, General, 2nd Ed., Vol. 2, Sec. 3.
TM 9–217	Submachine Gun, M3
O.O. 472.5/3217	Military characteristics for submachine gun desired by Infantry and Cavalry.
OCM 17493	Use of plastic 20- and 50-round drums for Thompson, M1928A1
R & D—1/1/42, p/158	"
O.O. 472.5/505	"
Infantry Board Report No. 1272	
OCM 19653	Stock Breakages
O.O. 400/7594—5/26/42	"
O.O. 400/3295/56396	"
Drg. A, Auto-Ord. Corp.	"
OCM 17977—3/26/42	M1 recommended for standardization, M1928A1 classified Limited Standard. Read for record 4/30/42, OCM 18155
R & D—4/3/42, p. 163	Blish locking eliminated, M1
R & D—7/1/42	M1
OCM 19088—10/29/42	M1A1 (modification)
R & D—7/14/42	M1A1
OCM 12655	M1A1 standardized, read for record.
OCM 18056—4/13/42	M2 recommended for standardization
OCM 18156—4/13/42	M2 classified Substitute Standard
OCM 20773—6/17/43	M2, classification as obsolete recommended; read for record OCM 21000, 7/8/43
R & D—5/5/42, p. 160	Hyde Inland (M2)
R & D—7/1/42, p. 82	" " "
R & D—9/14/42, p. 162	M1 and M2—Safety of
OCM 19007—10/8/42	Requirements (T15)
OCM 19401—12/24/42	M3 recommended for standardization. Read for record OCM 19507, 1/14/43
OCM 19217—11/26/42	9 mm/cal. .45 conversion of M3
OCM 19080—10/29/42	Compensators unnecessary. Read for record OCM 19159, 11/12/42
R & D—8/12/42, p. 157	T15 (M3)
R & D—9/14/42, p. 162	M3
R & D—10/14/42, p. 157–158	Swaged barrels, use of on M3
R & D—11/13/42, p. 161	T20 (M3), fire selector unnecessary on
R & D—12/26/42	T20 (M3)
R & D—2/17/43, p. 302	M3, cleaning brush for
R & D—3/17/43, p. 302	M3, barrel length
R & D—4/10/43, p. 304	M3, magazine test
R & D—5/8/43, p. 304	M3, extraction
R & D—6/14/43, p. 303	M3, production
OCM 19335—12/17/42	T2
O.O. 472.5/1847	T2
R & D—9/14/43, p. 162	New Auto-Ordnance guns (T2)
OCM 15575—1/25/40	Smith & Wesson. First report on S&W gun may be found in Aberdeen Partial Report 111, 12/4/39
OCM 16455—2/6/41	Reising
R & D—6/1/41, p. 205	"
R & D—1/1/42, p. 157	"
R & D—3/11/42, p. 167	"
Letter: Capt. Meyer to Col. Borden, 7/18/41	"
Letter: Lt. Col. Studler to A.P.G., 10/8/41	"